

1 1. A superconducting electric motor comprising:
2 a rotor assembly including:
3 at least one superconducting winding which, in
4 operation, generates a flux path within the rotor assembly;
5 and
6 a support member which supports the at least
7 one superconducting winding, the rotor assembly configured
8 to operate in a synchronous mode of operation at
9 temperatures wherein the superconducting winding exhibits
10 superconducting characteristics and in a steady-state
11 induction mode of operation at temperatures wherein the
12 superconducting winding exhibits non-superconducting
13 characteristics.

1 2. The superconducting electric motor of claim 1
2 wherein the rotor assembly includes induction structure for
3 carrying current at levels sufficient to allow the steady-
4 state induction mode of operation.

1 3. The superconducting electric motor of claim 1
2 wherein the rotor assembly includes induction structure
3 configured to allow the superconducting motor to generate a
4 starting torque which is at least 50% of the rated torque in
5 the induction mode of operation.

1 4. The superconducting electric motor of claim 3
2 wherein the rotor assembly includes induction structure
3 configured to allow the superconducting motor to generate a
4 peak torque which is approximately twice the rated torque in
5 the induction mode of operation.

1 5. The superconducting electric motor of claim 4
2 wherein at least a portion of the induction structure is

3 spaced from the at least one superconducting winding by a
4 thermal isolation vacuum region.

1 6. The superconducting electric motor of claim 5
2 wherein said at least portion of the induction structure
3 spaced from the at least one superconducting winding by a
4 thermal isolation vacuum region includes an electromagnetic
5 shield member.

1 7. The superconducting electric motor of claim 6
2 further comprising a cryostat positioned between the thermal
3 isolation vacuum region and the electromagnetic shield
4 member.

1 8. The superconducting electric motor of claim 5
2 wherein said electromagnetic shield member includes a
3 conductive, non-magnetic material.

1 9. The superconducting electric motor of claim 4
2 wherein the induction structure includes the support member
3 which supports the at least one superconducting winding.

1 10. The superconducting electric motor of claim 9
2 wherein the induction structure further includes an
3 electromagnetic shield spaced from the at least one
4 superconducting winding by a thermal isolation vacuum
5 region.

1 11. The superconducting electric motor of claim 10
2 wherein the support member includes a plurality of
3 laminations, each lamination lying in a plane parallel to
4 magnetic field flux lines extending through the laminations
5 during operation of the superconducting electric motor.

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1 12. The superconducting electric motor of claim 1
2 further comprising:
3 a stator assembly electromagnetically coupled to the
4 rotor assembly; and
5 an adjustable speed drive provides an electrical
6 signal to the stator assembly.

1 13. The superconducting electric motor of claim 12
2 wherein the adjustable speed drive provides a signal at a
3 first frequency to the stator to start the superconducting
4 motor in the synchronous mode of operation and provides a
5 signal at a second frequency, less than the first frequency,
6 to the stator in the steady-state induction mode of
7 operation.

1 14. The superconducting electric motor of claim 1
2 wherein the superconducting winding includes a high
3 temperature superconductor.

1 15. The superconducting electric motor of claim 1
2 wherein the superconducting winding is a racetrack shaped
3 winding.

1 16. The superconducting electric motor of claim 1
2 wherein the support member is formed of aluminum.

1 17. A superconducting electric motor comprising:
2 a rotor assembly including at least one
3 superconducting winding comprising a high temperature
4 superconductor, the superconducting winding, in operation,
5 generating flux within the rotor assembly, the rotor
6 assembly and stator assembly configured to operate in a

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7 synchronous mode of operation at temperatures wherein the
8 superconducting winding exhibits superconducting
9 characteristics and in an induction mode at temperatures
10 wherein the superconducting winding exhibits non-
11 superconducting characteristics;
12 a cryostat surrounding the rotor assembly to
13 maintain the at least one superconducting winding at
14 cryogenic temperatures; and
15 induction structure, which during operation, carries
16 current at levels sufficient to allow the steady-state
17 induction mode of operation of the superconducting electric
18 motor, the induction structure including:
19 a support member which supports the at least
20 one superconducting winding; and
21 an electromagnetic shield surrounding the
22 cryostat and the at least one superconducting winding.

1 18. The superconducting electric motor of claim 17
2 further comprising:
3 a stator assembly electromagnetically coupled to the
4 rotor assembly; and
5 an adjustable speed drive provides an electrical
6 signal to the stator assembly.

1 19. The superconducting electric motor of claim 18
2 wherein the adjustable speed drive provides a signal at a
3 first frequency to the stator to start the superconducting
4 motor in the synchronous mode of operation and provides a
5 signal at a second frequency, less than the first frequency,
6 to the stator in the steady-state induction mode of
7 operation.

1 20. The superconducting electric motor of claim 17
2 wherein the support member includes a plurality of
3 laminations, each lamination lying in a plane parallel to
4 magnetic field flux lines extending through the laminations
5 during operation of the superconducting electric motor.

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1 21. A method of operating a superconducting
2 electric motor of the type including a rotor assembly
3 including at least one superconducting winding which, in
4 operation, generates a flux within the rotor assembly, and a
5 support member which supports the at least one
6 superconducting winding, the method comprising:

7 monitoring the temperature of the superconducting
8 winding;

9 operating the superconducting motor in a synchronous
10 mode at a temperature wherein the superconducting winding
11 exhibits superconducting characteristics; and

12 operating the superconducting motor in a steady-
13 state induction mode at a temperature wherein the
14 superconducting winding exhibits non-superconducting
15 characteristics.

1 22. The method of claim 21 wherein operating the
2 superconducting motor in the synchronous mode includes
3 providing an electrical signal to a stator assembly,
4 electromagnetically coupled to the rotor assembly, the
5 signal having a first frequency; and

6 operating the superconducting motor in the steady-
7 state induction mode includes providing a signal to the
8 stator assembly at a second frequency, less than the first
9 frequency.